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ABSTRACT

This examination of instructional development from a futurist's perspective focuses on three questions: (1) What are the probable future developments in educational technology that will affect instructional development?; (2) What are the probable future developments in learning and cognition that will affect instructional development?; and (3) What are the social trends that will affect the future demands for and resources available to instructional development? Both theoretical developments and impending innovations are considered, and implications for the training of instructional developers and for the nature of their practice are described. The importance of flexibility and the use of new tools, both physical and conceptual, are emphasized. (47 references) (Author/EW)

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VIII. FUTURES

Chapter 47

A Futures Perspective on Instructional Development

Carol D. Blalock

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Instructional developers have for years been predicting the future of the ID movement. Some writers have predicted a bright future, some have predicted the demise of the movement. Perhaps those who have been making the analyses are too close to the action to see all of the ramifications of the system(s). This chapter presents a futurist's perspective on ID. Perhaps we should know how our profession is viewed by someone not directly involved in the delivery of the services we normally provide.

INTRODUCTION

The future of instructional development or of any other educational activity cannot be predicted by simply extrapolating from existing trendlines. Drucker (1968) examined the development of Western culture in the last half-century and termed this period an "Age of Continuity," the period showing the least change in the last three hundred years in terms of agriculture and world commerce. During this time of continuity, economic growth was extensive, particularly in countries which were economically well-developed before 1913. The foundations for this were so solidly established by prior generations that this growth has survived the trials of the last fifty years. We are now, Drucker says, in an "Age of Discontinuity" in terms of technology and the world economy. It may be a great age. However, he predicts that it will be a time of many changes, since the foundations previously understood and relied upon have shifted under our feet.

In a rapidly changing world a field as technology-dependent as instructional development (ID) is also changing. The concept underlying ID reflects a network or a system of individuals, functions, and influences in a state of dynamic equilibrium. Abedor and Sachs (1978) have provided a three-part conceptualization of the centers, agencies, and programs which have as their goal the improvement of teaching: Faculty Development (FD), Organizational Development (OD), and Instructional Development (ID). Faculty development emphasizes the shaping of the skills, methods, understanding, knowledge, and techniques of each faculty person.

Organizational development strives to optimize the organizational environment, form, or procedures under which learning and instruction take place. Instructional development, in contrast, pinpoints the systematic design, advancement, practice, and evaluation of instructional curricula including lessons, materials, and courses. People and organizations engaged in instructional development must operate within intricately-balanced configurations which have characteristics influenced by instructional change (Rogers and Shoemaker, 1971). Thus, ID, as a field, both conditions and is conditioned by changes in the state-of-the-art of many disciplines, such as learning theory, curriculum development, cognitive and behavioral psychology, computer and data-processing technology, and electronic communications.

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In assessing the probable future of ID we find ourselves examining three questions: (1) What are the probable developments in instructional technology which will determine the instructional developer's armamentarium? (2) What are the probable developments in our understanding of cognition and learning which will help us to diagnose needs, identify learning styles, and prescribe learning strategies? (3) What are the social trends which will determine the future demands for instructional development and which will control the availability of resources for education?

DEVELOPMENTS IN INSTRUCTIONAL TECHNOLOGY

In our society education is perceived as a pervasive influence serving the needs of all persons in many contexts. The keynote speaker at the "First National Conference on Education and the Future" in Houston, Texas, (McHale, 1978) said that "new developments in telecommunications and computer technology may be as significant for education as the Gutenberg press." Developments in technology that may affect education include: micro-computers, micro-processors, bubble memory, lasers, holography, optic fibers, satellite-to-rooftop communications, video discs, charge-coupled devices and the application of electronic technology to communication (Lewis, Harrison, et al., 1978). A new age may be arriving in education with the use of electronic technology; however, the increased use of technology does not assure the improvement of instructional development specifically or of education generally. Nonetheless, it has been shown that telecommunications can be used in instructional programs as a way to cut costs under certain conditions (Dede, 1980).

Instructional technologies in use at the present time which could cut costs include home television, instructional calculators, home terminals for large computers, videodiscs with or without personal computers, and electronic communication and information processing. These five educational technologies illustrate the possibilities available in adaptation of the teaching/learning model (Dede, 1980). Learning through home television could be accomplished without a computer link-up by creation of a national programming system providing programs analogous to "Sesame Street," which has revolutionalized preschool television programming. The combination of carefully selected curricula appropriate to specific cognitive and experiential levels might be combined with entertainment. Curricula designed for each age-level (including adults and the aged) could be released via multiple-channel cable television. Approximately 95 percent of all households have television at this time and cable television channels, already widely available, should be available soon in almost all areas of the nation.

An advantage of national television programming would be that all citizens might have the opportunity to benefit from standardized learning experiences on such topics as citizen literacy,* instruction for all learning levels being produced using individuals with high-quality acting talent. such programs may be supplemented by paraprofessionals who would lead small-group discussions designed to encourage learners to make the televised materials their own through reaction, internalization, and personalization. A major strength of television programming is its capability for repetition, which could replace much of the current teacher-led socialization at all age-levels. Thus, time currently spent on "real world coping skills" could be lessened. Further savings might also result from savings in travel and facilities. However, production expenses will always be high for technological instruction of this kind; therefore, to be cost-effective, a large audience would be required.

Inexpensive and effective calculators can be programmed for use in the tutorial approach to instruction according to Dede (1980). These calculators can perform semi-sophisticated, computer-assisted instruction in several modes. In the tutorial mode, the calculator presents basic material, questions the learner, and corrects errors. The inquiry mode in which learners request a specific fact and receive the answer is another instructional mode for calculators. Dialogue with the calculator involves a general question which results in a complex answer. The final mode of calculator-supported instruction mentioned by Dede (1980) includes both explanations and interpretations. Complex learning is presented and a general response is requested. The costs of such instruction would be quite reasonable, but the relative economy of the mode may not be adequate to override the possible depersonalization which could be built into such a system, or the risk of a programming error resulting in people learning the same error nation-wide. Content bias is also a possible risk.

Home terminals for large computers, according to Dede, are the means through which a large central computer could deliver programs into homes utilizing cable television. Such a network "sets up a multiple-person, interactive, artificial-intelligence-based learning simulation" (1980). An advantage of this instructional system is that learner response on the home terminal results in a message being returned to the central computer over the cable. Creativity and higher-order cognitive skills, as well as interaction, are features which make the use of this instructional technology attractive to learners. Input would be typed onto a home keyboard and relayed to a large computer. Skills to be acquired include group problem-solving, computer programming skills and distance-

*Citizen literacy refers to an awareness of those public issues of critical importance to the national citizenry.

communication skills. Research has shown that the motivation and involvement-level of learners using this instructional technology is very high. Although costs for personnel, travel, and facilities might be saved, developmental costs would be extremely high. Dede states that "artificial intelligence software can require up to 10,000 hours of programmer time for each hour of instructional time produced" (1980). The high production costs would require a large learning population in order to be cost-effective.

The fourth example of instructional technology to be considered involves videodiscs coupled with personal computers. According to Dede this technology involves videodisc images-with-soundtrack interacting with microcomputers. Electronically-recorded material is presented, reacted to, and modified depending upon learner response. With this system the response-range is more limited and fewer variations are possible than is the case with the larger central computer system. As with other technological instructional possibilities, production costs are enormous while costs for actual use would be quite small. According to Hunt (1980), educators see the personal computer as a "stand alone, small, interactive microprocessor with great potential and versatility." He believes that the work of Orlosky and Smith (1972) indicates that personal computers will not survive as classroom aids. However, the business world envisions the personal computer as part of a system for home and business information because it includes the elements of television, language laboratories and teaching machines, and is a computer. It can be seen as related to cable TV and the telephone in that it affords new dimensions personally and functionally.

Electronic communication and information processing is a fifth possibility as an aid to instruction. Included within this category is electronic mail, computer conferencing, computer search, and information processing options, all of which may be means to increased educational efficiency (Dede, 1980). Electronic mail relays ideas swiftly and inexpensively to distant locations and can act as support for the development of a statewide or national networking system. A computer conference allows people to act as a group over long distances and within self-selected timeframes. Computer searches can acquire needed information within extremely short timeframes allowing library and research costs to drop. Information processing (word processing) assists in the writing and the editing of manuscripts. These technologies aid in reducing professional "busy work" and their costs must be examined in light of institutional priorities.

The technology for the five instructional possibilities mentioned is now in existence; however, only limited software is presently available. Joseph (1979) in his speech to the World Futures Society Education Section discussed computers of the future with respect to information storage capacities. "The Silicon Revolution" would include first and second-generation electronics. He saw the first generation as including "smart" machines such as books-on-a-chip, courses-on-a-chip, doctors-on-a-chip, managers-on-a-chip, and politicians-on-a-chip, with each chip holding 16,000 bytes of Random Access Memory, or 16,000 items. His projection of "people amplifiers" for the second generation includes "smart" systems-on-a-wafer, schools-on-a-wafer, or libraries-on-a-wafer. The whole movement to high-speed integration technology was seen by Joseph as supported by hardware development. However, he felt that 10 to 15 years would be required to debug this hardware. Education will clearly be impacted by the developments in information storage, as will instructional development, but neither Joseph nor any other futurist can be certain what this impact might be.

Norris (1977) believes that educators should assemble and configure various technologies into a system "that does what the present educational process does" but accomplishes this with a capital-intensive rather than a labor-intensive process. His suggestion for national and international networks includes computerized control with the main method of delivery being computer-aided instruction involving computer-aided videodiscs, touch input, and audio input and output. Computer-aided and computer-managed instruction would form the nucleus of the integrated terminal subsystems. Norris recommended the PLATO system of Computer Based Education for use because of advantages which include patience, personalization, versatility, and high-quality delivery. The PLATO system uses many forms of media and structures while being applicable to any knowledge-based information exchange. The interaction with individuals or groups, audio and visual responsiveness, and extremely large memory make PLATO a possible choice for a learning-center network. The learning-center network would represent the cooperative efforts of business, government, and educational institutions, and would offer a wide range of curricular materials. The cost for the development of one network could be up to one million dollars and a large target population would be necessary in order to justify the cost. The many obstacles to the marriage of education and business in forming a network of this kind must be considered. Teachers may perceive technology as a threat to their jobs, or a more general resistance to innovation in education may occur. Additional concerns include quality control, the public's dislike of the idea of monetary profit in education, and/or the desire to preserve individual identity. The rate at which obstacles to the use of technology in educational design are overcome depends upon the rate of attitude changes among educators, administrators, and the public.

Morgan (1978) believes instructional development is about two decades old. Instructional development, instructional systems development, instructional design, and educational engineering are all labels used to describe instructional development. Apart from variations in name

preference, a look at the origin, current status, and the future of the field might be useful. Instructional development, according to Morgan, received its strongest impetus from the work of B. F. Skinner and others on programmed instruction (1958). He believes that Skinner's work caused the convergence of three disciplines: communication, management science, and behavioral science. For many people, the field of communications including home television, complex communication networks, message transmission, information storage and retrieval, as well as other technologies, represents the body of instructional development. For many years, overhead projectors, slide/tape machines, motion-picture projectors, and radio and television have been a familiar part of the instructional process. These communications systems, those of the past and those of the future, potentially can be integrated to form a single instructional package having great impact upon the learner. These tools have been useful, and can be more so in the future; however, research demonstrating their impact upon the quality of the learning experience has so far been limited. Unless communications specialists join with behavioral scientists to apply the principles of learning to the design of the framework, sequence, and type of information to be transmitted to the learner, instructional development cannot become a "mature field" (Morgan, 1978).

DEVELOPMENTS IN COGNITION AND LEARNING THEORY

Current and future developments in our understanding of cognition and learning which will help us to diagnose needs, identify learning styles, and prescribe learning strategies can be of great value to instructional development. Psychologists have intensively explored the learning process for over fifty years and numerous alternative theories have been developed. The gap which exists between theory and practice has been slowly bridged in terms of improved instructional practices. In the 1930s Luria (1980) sought to document the primitive mind by working with preliterate peasants in remote areas of Uzbekistan. Luria's interest was two-fold: he wished to document the operations of the "primitive mind" existent in people who led a simple life and had no education; and at the same time he wished to seek educated individuals for comparison in order to determine both the degree and the manner in which primitive cognition is replaced or refined by more advanced forms of reasoning. Luria's form of research for obtaining responses was similar to the probes used by Piaget in his work with children. Luria demonstrated again and again that questions answered by people from Uzbekistan were answered in a manner that differed cognitively from those answered by educated Westerners or Easterners. The peasants' answers revealed general insensitivity to abstract forms of classification. Resistance to reasoning through language was evident to Luria. Only those people who had entered school had sensitivity to hypothetical, linguistic contributions, or to the superordinate constructs of "umbrella" categories. Although Luria's work was in many ways equilivalent to that of Piaget in the Western world, because of Soviet politics, he could not publish his results when they were obtained. He finally published his findings in 1960, almost thirty years after the initial work had been done. Gardner (1980) summarized Soviet psychology in relation to Western psychology. Pavlov and Bekhterev viewed the mind primarily as Skinner has, as a fundamentally physical reflex with nothing special about consciousness, will, or intention. Another, equally reasonable point of view emphasized consciousness and other special features, and questioned whether an objective science of psychology was achievable. Luria, Vygotsky, and their associates thought that a fusion of these two traditions was achievable. They wished to find an objective basis for the highest of human achievements (Gardner, 1980). The study of primitive forms of mentality created a pathway from reflex to thought, from elementary perception to abstract language, and from reaction to planning. Luria and his associates suggested that the single factor that made man special was his surrounding cultural context.

Kelly's personal-construct theory (1955) is a theory of cognition based upon a unique set of assumptions regarding the nature of mankind and of the human universe. Kelly's theory develops Luria's observations concerning the various levels of human constructs and their interrelationships with each other. Three assertions are made by Kelly in relation to the universe: humanity knows the universe to be real and not the result of someone's imagination; humanity knows that the universe can be understood only by repeated encounters over a period of time; humanity knows all events are interrelated.

Kelly's assumption that the universe contains real events and objects is complemented by his assumption that a person's internal events are also real. Thoughts about external objects or events have an internal reality as authentic as the happenings themselves. Kelly believes that our knowledge about the universe is determined by the extent to which we interpret it. For individuals, this interpretation gradually approaches by successive approximations a true picture of events. Unlike purely subjective existential theorists, Kelly accepts the possibility of accurate knowledge of objective reality. Kelly's theory views the human being as trying out interpretations or constructions for their predictive validity in the world s/he is beginning to understand.

Kelly believes that some aspects of existence can only be made comprehensible through the notion of time. Behavior is explicable only if seen in the context of the future as well as in that of the present and of the past. Kelly's personal-construct theory includes the notion of an integrated universe which is consistent with the

development of a system of ideas designed to bring coherence to one's world-view. He sees people as constantly trying to construe relationships where there were none perceived before (Bannister, 1968).

Kelly visualizes humans as distinguished by their ability to not only respond to life's events but also to represent their environment. Personal-construct theory is based upon people knowing the world by means of the constructions they place upon it. Humans are bound by events to the degree that they have the ability to construe them. Kelly's philosophical position has been called constructive alternativism (Bannister, 1968).

Personal-construct theory (Kelly, 1966) has demonstrated the usefulness of looking at human and scientific endeavors as sharing relevant similarities, in that in both people pinpoint issues, observe issues, become intimate with problems, form hypotheses, test hypotheses, relate results to expectancies, control investments so that they can understand what leads to which outcomes, produce generalizations, and broaden dogma in view of experience. Kelly's (1977) unique contribution to psychology was the introduction of a single language for explaining human processes, making the psychological nature of scientific inquiry capable of providing new insights both into the potential of man and into the nature of science. Kelly did not claim to have reached a total understanding of human process, but he did feel that the idea of "man-the-scientist" was worth exploring. Recent research using Kelly's personal construct theory and repertory grid analysis has revealed that when perceptions and values of three groups were compared in relation to a current social problem, many perceptions occured in common (Blalock, 1980). When groups can agree on perceptions, they can be led to discuss, clarify, and develop valuations related to those perceptions. In the study above, only one construct represented a shared value among the three groups, indicating the existence of functionally-defined group differences. Although specific perceptions will be valued differently by the different groups, the existence of common perceptions and of common dimensionalities of valuing should greatly facilitate communication. This approach to curriculum planning and educational strategy is based upon a recognition of the difficulty of comprehensively informing through a broad-based community education program. Such methodology provides a way to identify commonalities and differences which contribute to group identity. Any instructional development program which ignores the valuational aspect of educational programs will fail in achieving effective communication with the membership of those groups whose values differ significantly from the values assumed in the curriculum design. Research has described a paradigm for mapping such values with regard to social issues (Blalock, 1980).

Educators have traditionally accepted responsibility for the transfer of information, the organization of that information into rational, hierarchical structures, and the use of knowledge as a basis for ethical participation in the democratic process. Historically, the application of these responsibilities were restricted to the young; but an emerging role of education is the extension of these functions to all of society. If curriculum is the plan by which education functions, then workers in instructional development as well as in curriculum development must find methods to develop organized knowledge and thought and present it to specific target populations. While a variety of learning theories are available which provide specific strategies for implementation of the educational process, there is need for a unifying theory of perception and thought which transcends differences in strategy. Personal-construct theory provides us with that unifying picture. It permits the identification of various levels of intellectual functioning for which the educator must take responsibility. Thus curriculum planning can begin with the transfer of factual information, proceed through the development of organizing constructs, explicitly facilitate the testing of constructs against reality, and culminate in the evolution of high-level supraordinate constructs which serve as guides for moral action. The techniques used in research deriving from Kelly's personal-construct theory can be used to visualize the status of an individual or group at any of these levels, thus providing baseline data upon which to base planning.

Another application of learning theory, programmed instruction, had its first debut in the 1960s; while many programs did not work very well, others did (Morgan, 1978). It was possibly the first time when some of the conditions of human learning were influenced by a degree of experimental control. Programmed instruction fell from popularity quickly for various reasons; however, a large quantity of materials remain in use. Morgan (1978) states that for the first time, educators in significant numbers were emphasizing the outcomes of education instead of the processes. Additionally, educators became more aware that student failure might relate to teacher failure or to the failure of instructional materials. Interest in instructional development increased as a result of programmed instruction, and creative responses were devised to meet this interest.

Instructional development grew with the advancement of learning theories into the management-based systems of the present (Willems and Brown, 1980). Curricula of this type identify specific skills, knowledge and behavior needed by students. The conditions necessary for performance and the minimum acceptable level of attainment are also defined. Some high schools and grade schools require demonstrated competencies as prerequisites for graduation or for movement to the next grade. Although possessing some value, there are limitations to this type of curriculum. The most often-mentioned criticism at this time is that competency-based curricula stifle

creativity. Supporters of competency-based curricula have not answered this question to everyone's satisfaction at present. Medawar (1972) offers a perspective which might bring both sides closer together. He states that in "the conception of the scientific process, imagination and criticism are integrally combined. Imagination without criticism may burst into a cosmic profusion of grandiose and silly notions. Critical reasoning, considered alone, is barren. The romantics believed that poetry, poses, the creative exploit, was the very opposite of analytic reasoning, something lying far above the common transactions of reason with reality. And so they missed one of the very greatest of all discoveries, of the synergism between imagination and reasoning, between the inventive and the critical faculties." Viewed in this way, competency-based education can be more readily accepted, but accepted only in areas appropriate for the thinking processes of human beings.

Willems and Brown have classified thinking into three types, and have discussed these in terms of competency-based curricula. Type I thinking involves instinctual and automatically-learned responses, spoken of as "unconscious reactions." Type II thinking involves "conscious activities" which make up most of today's competency-based curricula. Examples of Type II thinking are rote learning, drill and repetition. Sometimes these are called "recipe-type" responses. Type III thinking depends upon Type II thinking and synthesizes all thinking into an understandable whole. Examples include speculation, reflection, theoretical production and inspiration. Willems and Brown state that most really good ideas do not start with logical thought but begin from intuition. Later the ideas are tested by logic. Creativity functions as the delicate relationship between rational and intuitive thought. Most competency-based curricula in schools have relied upon Type II thinking. Type I thinking is usually not considered to be the school's responsibility and Type III thinking is seldom provided for or even encouraged in a competency-based school curriculum. Civilization is challenged by Type III problems which require synergistic outcomes if solutions are to be found. Problems such as food-population imbalances, energy, environmental pollution and lack of international understanding are some of the Type III problems referred to above. Attempting to solve Type III problems with Type II solutions results in spurious solutions based upon logic and rationality. Thus, Type III thinking is critically needed. Natural evolution no longer determines or defines people; they now are capable of selecting the most appropriate learning environment within which to acquire their own critical survival skills.

As a result of recent studies in cognitive learning and memory, researchers in cognition have demonstrated considerable progress in understanding the cognitive processes, such as selective attention, imagery, verbal encoding, memory and retrieval (Paivio, 1971). Recent research in artificial intelligence and computer technology leans toward a cognitive emphasis. Interest in cognition is not new. Aristotle's model of memory stated that we remember information only by forming images of it: and that images may be recalled through sequential ordering and association with one another, by applying the principles of similarity, contrast, and contiguity (Aristotle, 1964). Wittrock (1978) mentions three relations existing between education and cognitive processes in the brain. First, recent brain-research findings suggest that process-oriented paradigms can result in an understanding of ways in which human learners construct meaning from instruction. Second, recent brain-research findings are consistent with cognitive models of learning and memory. Third, human brain-research findings are consistent with the ancient art of teaching and its ideas.

An interesting summary of brain-research findings points out that the brain actively constructs models of the world (Jerison, 1977). Luria and Trevarthen (1973, 1974) found that human brains actively select, transform, organize and remember information. Learners were seen, not as passive receivers of information, but as actively constructing personal meanings from this received information. One outstanding finding of recent research on the human brain demonstrates that its cortical hemispheres usually organize and encode information in different ways (Bogen, 1977). In about 98 percent of the right-handers and two-thirds of the left-handers, the left cortical hemisphere facilitates propositional, analytic-sequential, time-oriented serial organization adapted well to learning and remembering verbal information. In these people, the right hemisphere specializes in appositional, synthetic-gestalt organization most adapted to processing information in such a way that elements of thought gain meaning through their association with other elements of thought. The recent research on hemispheric processes of the brain helps to explain some of the results found in psychological research on verbal processes and imagery in learning, encoding and memory. The brain-research findings suggest that although both verbal and spatial modes of information processing exist, it is the type of organization which is imposed upon information that represents its constructed and remembered meaning (Wittrock, 1978); an image or other reproduction of the original presentation stimulus is normally not what is remembered.

In relation to the three types of thinking mentioned earlier by Willems and Brown, Type I thinking seems to be controlled by the inner brain, which is mainly responsible for subconscious and instinctual responses. Type II thinking seems to use only one hemisphere (usually the left) side of the brain, with the right side of the brain performing the passive function of support. For Type III thinking, it is likely that both brain hemispheres are communicating actively. The recent research on encoding and hemispheric processes suggests that the brain constructs meaning by

building analytic and holistic organizations upon information in such a way that curricular design, sequences of instruction, and different organizational strategies need to be individually prescribed. Furthermore, instruction with the purpose of creating gestalt-synthetic processes will differ from a picture-illustrated linear sequence of information. An inductive or nonlinear presentation of information is most likely to induce a synthetic processing strategy (Wittrock, 1978). Within the above discussion, learning-concepts gain new meanings. Reinforcement which is well-designed for one hemisphere's strategy may be poorly timed, random, or even worse for the cognitive strategy of the other hemisphere. The brain's organized multivariate reality constructions are probably more sophisticated than they are considered to be in the design of recent instructional materials. The usual roles of teachers and learners will be changed as new models of learning emerge from brain research.

The brain is not passively consuming information received from teachers. It actively constructs and interprets its own information and selectively creates meanings. The implication for instructional development is that in the future, instruction should begin with observation of the learner, knowledge of constructive processes, and individual differences. Wittrock believes that teachers need to recognize individual differences and facilitate the constructive processes of the learner.

Mertiz and Olander (1980) explore the precision management of instructional technology as an instructional model. They believe that through course management and careful measurement of student performance, and also through the informed use of media and microprocessors in instruction, more effective courses can be developed. The Center for Individualized Instruction, a branch of the Advanced Institutional Developmental Program, is developing effective courses at Jacksonville State University in Alabama. This center uses four techniques to achieve its goal: microprocessors, media management, and measurement. Management and measurement deal with the behavior of people, in that one defines roles and expectations and the other provides precise measurement of critical behaviors. The Center employs the Personalized System of Instruction (PSI) (Keller, 1968) for basic organizational structure of its courses. Precision Teaching or Precise Behavior Management (White and Haring, 1976) provides a behavioral measurement strategy which sets the student-behavior frequencies required to trigger program changes in the proper sequence and to permit the PSI's feedback loops to be supplied with data. Media and microprocessors are the other two relevant technologies. Individual courses have different mixes of media to support various instructional goals. Video-taped, audio taped, slide-taped, and filmed programs are represented. Microprocessors, as with media, are used at the Center to various degrees. Some courses do not use media or microprocessors at all, while in two, for instance, 15 commercial slide-tape modules are used in addition to lectures, and labs with microprocessors are used to provide complete interactive evaluation. Mertiz and Olander believe that the improvement of the instructional process through the use of instructional-development technology and planning has caused an effective behavior change in students. The effectiveness of learning is measured by the demonstrated change in recorded behavior from the beginning to the end of each unit. Data provided by the students make it possible for the instructor to effectively direct each student's learning. This approach might be viewed in terms of the prior discussion of teaching students to adapt to the future versus teaching them to plan and lead us into the future.

Cain (1979) has implemented the self-directed learning concept in such a way as to necessitate the development of a unique curriculum. Using a broad range of technology such as video, A.V., micrographics and data processing, several disciplines were arranged into broader teaching topics instead of traditional departmental courses. Staff of the University of Texas Health and Science Center undergraduate program at the Dental Branch believed after a number of years of topic-teaching that an individualized, learner-centered approach to the presentation of topics would be more effective. Each student was seen as taking more responsibility for the learning process, as well as faculty time being more productively spent working in small groups and individually. The faculty became planners and designers as well as producers of educational materials. Because the material was to be dispersed, not through the usual lecture approach, but through multi-media, small groups, and individually, an instructional-support group to assist faculty members was formed. The latter group included two instructional designers, as well as production specialists in such areas as television, photography, graphic arts/medical illustration, micrographics, audiovisual and technical services. Three full-time photographers and three medical illustrators were also included. The curriculum was divided into 20 phases which represented what usually comprised four years of dental study. Each unit contained a guide and a statement of content, objectives, instructional resources, a study plan, and evaluation materials. The University of Texas has, through this means, developed a student-oriented system to take advantage of media as a tool for rapid and, if necessary, repetitive dissemination of information to a learner. This program has allowed the student to move ahead of the class at times and devote more time to areas when needed. Faculty members are more free to facilitate the learning process.

Frymier (1980), a professor of education at Ohio State University, suggestes that during the past 20 years teachers, administrators and curriculum developers had been trying to find the "one best way" in which students learned. From the

mid-1950s to the mid-1970s innovation and curriculum development had a foothold. Changes in content, methodology, school organization and political policy (competency-based learning, individualized instruction, etc.) were common. Frymier sees the proposals for educational change made during the last 20 years as being primarily group solutions. Conventional ways of teaching reading were replaced by newer approaches with the assumption that those students who did well in the traditional programs would do better in the novel programs, and students who did poorly would do better under the new approaches. But this did not universally prove true. Students can learn inductively, deductively, vicariously, from direct experience, or through any combination of these. Because there is no "one best way" of teaching, use of curriculum materials, organizational arrangement, or use of time, educators may decide to give up the search for the "one best way" in favor of the concept that different learners have different educational needs. If clear goals and their measures of achievement are made obvious to teachers, then teachers functioning as brokers can effectively accomplish these by bringing students and information together. The question of whether teachers can conceptualize and make operational ways of working with different students, curriculum materials, and instructional procedures in order to maximize learning has been answered positively by Frymier. He believes that students are complex human beings and that teachers can learn to think of their students as complete human beings.

Instructional development has had an impact upon the medical fields and upon business and industry. The reason for this impact has already been discussed in terms of certain fields becoming more product-oriented than process-oriented. Patton (1980) discussed the future of educational technology in industry. Educational technology has had a significant influence on field-training in business and industry, especially in the analysis of course development. Course content is defined in terms of need, task, and target population. In the past, course content was determined by what the instructor had himself been taught during his student days. Today, the course content of most technical and skills courses is based upon instructional objectives resulting from task analyses. Teaching strategies are no longer limited to lecture, on-the-job training or vestibule. Today's training specialist develops a program upon request, first conducting an analysis to determine needs and the appropriate methodology for solving the training problem. The most significant impact has come from educational technology in combination with behavior management. To further improve the role of educational developers in business and industry in the future, the following suggestions are made by Patton: (1) shorten course-development time without adversely affecting quality, (2) use subject-matter experts more effectively, (3) apply educational-technology techniques to the field of management development, (4) expand the scope of educational technology to include behavior maintenance, (5) achieve a greater awareness concerning the differences between adult learners located in a business setting and learners in other age-group/settings. In summary, further cooperation between academicians and trainers in the private sector will be necessary if major advances are to be made in the above areas.

Breakthroughs in brain research could one day result in people sniffing a nasal spray to improve their memories. Sigmund Freud predicted that every mental event would some day be understood as a result of chemical reactions in the brain. Today, some scientists are viewing the brain as a giant chemistry set. Panti (1980) reports that memory, concentration, and fear have recently been identified as chemical events. Implications for education include possible chemical treatment for increased creative ability, enhanced memory, and enhanced attention span. Vasopressin, first synthesized in 1968, is a hormone produced at the base of the brain in the pituitary gland. Scientists have found that, for certain people, a few whiffs of this chemical can improve memory, and the results are possibly lasting. Research at the University of Liege in Belgium on a group of males between 50 and 65 demonstrated that after three doses of vasopressin on three consecutive days, significant improvement was registered on memory and learning tests.

The side-effects of vasopressin are mild and include the elevation of the heartbeat rate and higher blood pressure. Researchers feel that the side-effects can be controlled by administering the drug in smaller doses over a longer period of time. At this time the drug is used primarily to treat amnesia victims; however, in the future, some form of vasopressin may help students sharpen their memory.

Panti approaches concentration as he does memory, by suggesting the use of another drug, ACTH/MSH, a natural brain protein which speeds up the brain and focuses its direction. ACTH/MSH is present in two hormones produced in the pituitary gland. Students injected with the compound were more sensitive to differences in geometric figures as well as more able to concentrate on their studies for longer time periods. The most significant discovery in the use of ACTH/MSH appears to be that it is the only significant drug that can be used in treating mental retardation. Retarded patients given injections were better able to comprehend tasks and demonstrated clearer thinking.

Creative drugs are being explored by Arnold Mandell, a psychiatrist at the University of San Diego, with the hope of enhancing creativity through the use of hallucinogenic drugs. A psychiatrist, Claudio Naranjo, experimented on students with a few of Mandell's drugs and found one compound which seemed to produce neither euphoria nor speeding, but rather a feeling of newness and novelty in a normal situation.

Another compound relieves depression but also creates feelings of high motivation. No pill will turn an ordinary person into a genius or generate motivation where there is none present, but if a person's creative instincts are blocked, psychotropic drugs may sometime in the future be of help. Mandell states that he believes that it will take decades for society to introduce into common usage a performance or life-improving drug, but it could actually be available by 1990.

Artificial intelligence or microelectronic intelligence can be incorporated into almost any product large enough to contain it (Roland, 1979). Pocket calculators and digital watches are only the beginning. There are more than 200,000 low-cost personal computers being used in homes, offices, schools, and factories, and that number is growing rapidly. Many integrated circuits can perform tasks programmed by the user and are called microprocessors. Microcomputers are more economical to use for specific tasks because there is no need to link up with a large master computer. The "small wonders" of tomorrow's world will include: instant information provided by a pocket-sized "dator" combining the features of the CB radio, the giant computer, and the telephone system; home banking to enable individuals to deal directly with banks from their homes; self-guided planes and cars; and classrooms in which students may build and program their own personal computer systems as a part of the school curriculum. From these advancements could come the man/machine symbiosis (Jennings, 1979) in which it may be possible one day to link a human mind directly with a computer. Jennings believes that since brain activity and memory in living organisms appear to be functions of minute chemical changes induced by electric flow, man and computer could become directly linked, and this might result in "instant learning." Any individual with a need to study or practice could benefit from the "brain recordings" of another individual who would pass these on through the computer. Linking the human mind to computer-assisted sensors could enable humans to use any wavelength of the electromagnetic spectrum to "see." These sensors might create a sense of union between man and machine. For instance, a pilot might be "one" with his plane, thus reducing the reaction time required to change its/her/his direction of flight.

Michael--who for 17 years was an intellectual exile, unable to share his thoughts with others because of garbled speech resulting from cerebral palsy--began working a year ago on a computer-based learning system called LOGO. LOGO was developed at the Artificial Intelligence Laboratory and the Division for Study and Research at the Massachusetts Institute of Technology, and has enabled Michael to write dozens of his own computer programs. He now teaches a computer class for other handicapped people with the hope that a communications bridge can be formed for those who cannot express themselves any other way. For many handicapped students, hitting a key on the keyboard is much easier than speaking or writing, and the instant feedback provided on the computer screen is more reinforcing than the confused responses they might otherwise receive from teachers. LOGO can record all input information and errors made by students for later analysis. MIT researchers are using LOGO to develop aptitude tests for handicapped children by redesigning tests originally designed for children who are normal. One of the tests, a measure of concrete reasoning abilities, is a computer version of Piaget's seriation task. A battery of tests such as these will help teachers and children to more accurately gauge the abilities of handicapped children (Ray, 1980). LOGO may give children self-confidence and a bridge to the normal world.

Genetic engineering, a frontier in the biological sciences, has explored the possibility of learning how to cure monogenic hereditary diseases and concern has been expressed that biologists might also be able to modify personalities genetically. On technical grounds Davis (1980) does not think the concern is necessary, because of the large number of genes contributing to any behavioral trait, and because most of them will have made their contribution to a person's individuality before birth. Thus the personality would remain as it was, even though the genes forming it might be altered. Davis believes that most knowledge is double-edged, with both good and bad implications and good and bad applications in a given culture. He suggests that this principle applies not only to knowledge providing new technologies bestowing new powers upon us, but also to knowledge concerning the biological roots of human nature. The acceptance of such knowledge often encounters resistance because it might contradict formerly treasured preconceptions and have political consequences. A safeguard might be to realize the limited power of science in this area in that prescribing solutions to moral problems involves value judgments as well as reality estimates. A more accurate perception of reality would be helpful since we have recognized that large-scale technological applications of the physical sciences have costs as well as benefits. In biology the concern comes not from present harm, but from hypothetical future harm. Thus, while genetic engineering isn't likely to drastically change our personalities, we do need to maintain an informed concern about its activities.

SOCIAL TRENDS AND FUTURE DEMANDS FOR INSTRUCTIONAL DEVELOPMENT

Robert Theobald (1980) expressed the view that a changed world now requires both the teaching of new bodies of knowledge and the teaching of this body of knowledge in new ways. He believes all of us to be a part of an organism within which the behavior of any part affects the well-being of other parts. Three social "strands," or sets of related trends, form an overall pattern illustrating the connectedness of all of the things

in life. Three social trends relevant to instructional development can be summarized under the following headings: the frontiers of the biological sciences, the frontiers of the behavioral and social sciences, and the frontiers in communication.

Davis (1980) in his discussion of the biological frontier, suggests that a basic property of the brain that is presently accessible to study on the molecular level and the cellular level is learning and memory. The results of studies with simpler organisms have shown that the cellular mechanisms for learning involve two kinds of alteration: in the functioning of existing synapses and in the formation of new synapses. Rapid progress in identifying the detailed nature of these changes is expected; however, the attempt to understand the physical basis for conscious learning is part of the much more difficult problem of consciousness itself. The set of phenomena could simply disappear as researchers try to dissect the causal connections. Davis states that perhaps consciousness will eventually be understood neurobiologically via some yet-to-be discovered concept. He does not see a return to a mind-body dualism but the emergence of a set of rules for intercellular information flow as unique as was the theory of molecular information storage several decades ago.

> "As biology delves more and more into human behavior it may be expected to interact increasingly with other disciplines concerned with understanding man. In this connection it should be emphasized that the reductionism of biology is only a heuristic device, deepening our understanding of any level or organization by relating it to other levels; the purpose is not to replace one level by another. In particular, the triumph of the mechanistic approach at the molecular level in no way reduces our appreciation of the unique intellectual, moral, and esthetic capacities of our species. Rather we can only stand in awe that life, evolving from inorganic matter, could develop these qualities" (Davis, 1980).

Progress in the social sciences is often demonstrated by advances in observational techniques and instruments (Simon, 1980). The theory of human rational choice and the newly-named discipline of cognitive science help to provide explanations for broad areas of human behavior. In the past three generations social science has sought to clarify the concept of rationality with the hope of better understanding human behavior. Simon is not assuming that all behavior is rational, but rather that human behavior is directed toward goals and the satisfaction of wants and needs; therefore, he sees it as directional. Research on rationality has two aspects; one to prescribe courses of action and the other to describe actual human behavior. The focus of the formal treatment of rationality is the theory of the "subjective expected utility" (SEU). SEU theory and its axioms were developed following World War II. The SEU axioms suggest that the person makes the most of "his or her expected utility in the light of subjective estimates of the probabilities of events" (Simon, 1980). The purpose is to preserve factual testing and the operationality of the axioms. If a number of observations are made of a rational person, through SEU theory it is possible to infer from the choices made by that person whether s/he is behaving consistently or not, and if so, to estimate the person's subjective probability distribution and utility function. This theory is important for three reasons. First, a precise definition of rationality is provided. Second, it makes clear the extent to which human rationality as an assumption is factual and can be tested. Third, it creates a conceptual structure for the use of normative methods in the study of real-world rational decision-making.

During the last 25 years, the most important development in the social sciences relates to the information-processing revolution as a way of understanding human thought-processes. The digital computer and related mathematical and engineering developments in information theory and control theory produced a new paradigm for psychologists and linguists. These theories and devices demonstrated a physical system for handling information embodied in symbols which could be used to make decisions or carry out the process of "thinking." Symbols in this sense represent patterns which can be stored, copied, compared, read and written (Simon, 1980). Therefore, a computer was seen to be a symbol system for carrying on thought-like activity. Computers were seen as providing a new metaphoric type of role. The question of whether a computer performs tasks in any way similar to the human processes or whether they are quite different remains to be answered. The effort to understand the relationship between complex information processing and human thought processes has sparked a new discipline -- artificial intelligence. A reformulation of theory in cognitive psychology has taken place and has revealed some basic commonalities between linguistics and experimental psychology.

Artificial intelligence is concerned with learning how computers can be programmed to do "smart" things. At present many artificial intelligence programs use the "brute strength" approach and do not at all imitate human processes for doing the same tasks (Simon, 1980). Computer programs that represent human cognitive processes are theories of how these processes function. To test these theories a great number of experiments are conducted with human subjects. Research presently underway includes comparing human subjects performing a difficult task while thinking out-loud with the computer simulation output. As research has accumulated, explanations of human

thinking for a significant range of problem-solving, pattern-finding and concept-attainment is possible. The research program of the information-processing psychologists includes extending the range of human performance studied to include more complex behaviors while linking theories of this complex behavior to already-existing theories and experimental data concerning simple information processes and their structures. Therefore, theories concerning long-term and short-term memory can be tested directly by experiments on some of the component-processes. This research should help promote the convergence between the focus on "simple tasks" and the emphasis on "higher mental processes." It should be possible to fit both into the same structure of information-processing.

The frontier of communication is the third trend to be discussed. Oettinger (1980) suggests that every society is an information society and every organization is an information organization. He has labeled "information" as a basic resource, like energy and raw materials. Questions like "Who has a resource?" "Who wants it?" "How can you get it?" and "What are the terms of trade?" link each resource to a political power. For information resources, traditional answers are no longer adequate because of large-scale integrated circuits and microcomputers. New answers will be necessary to handle such developments as competition between the computer industry and the telecommunications industry, reliance on satellites and other technical means to prevent war, growing occupations based upon providing for information flow, and controlling the domestic and international struggles over freedom versus control of information.

The three trends discussed, if placed within a systems model, can provide insight into the possible future status of a complex network system such as modern education. Construction of the model begins by an examination of the context in which the model is embedded. National leaders in education are recognizing the necessity for the coordination of cooperative networks of learning systems. For example, Cremin (1976) suggests that educational policies relate to a large variety of educational institutions and that education "...be looked at whole, across the entire lifespan, and in all situations and institutions in which it occurs." Networking through a systems approach has recently become of more interest to ID as the inter-connectedness of needs and resources becomes more obvious (Bass, Lumsden, and Dills, 1978). Branson (1978) discusses the systems concept as beginning in the mid-1960s and as represented by the definition of goals or planned outcomes and the purposeful consideration of various means for achieving those goals. The research suggested that we further understand the cognitive thought-processes of the learner as another essential component of ID. Exploring bodies of new knowledge in original, effective ways will allow ID to remain a growing and relevant field. ID has as its focus the individual student and seeks to enhance each person's growth through the most effective means possible. It, therefore, has no need to define "one" right way to accomplish learning but embraces the concept that for each person's inner perceptions a unique learning formula could be effective.

Education is also a means for facilitating participation in social decision-making. Toffler (1974) asserted that it was within the jurisdiction of the educator not to try to chart a definite course for the future but rather to provide a forum through which future alternatives could be explored. He hypothesized that since effective planning is crucial to participatory decision-making, the opinions of people involved with the consequences of the future should be included. Furthermore, he felt that any view dealing only with those outcomes advocated by a few specialists would not be achievable. He focussed on a viable alternative which included goals identified by the citizenry at large as well as those spotlighted by academics and their institutions. Future planners could then focus by choice on the social and ethical aspects of futurism.

Theobald (1980) argues that new patterns of thought designed to enable people to deal more effectively with their future must be taught, and that these must be taught in new ways. This is the fundamental challenge confronting education for all ages and levels. Small modifications to current patterns will not be enough. Overall conceptual patterns themselves are what are causing it to be impossible for us to give children or adults those conceptual skills which are required to deal with the pattern of events in today's world. People are confused as the complexity of events continues to increase. They will, according to Theobald, be unable to analyze their world as long as they use industrial-era models, which define events as predictable, understandable, and one-dimensional. Ambiguity must now become an expected part of our world.

Theobald mentions some further "driving forces" which are not likely to change much as a result of policy decisions over the next 20 years. The tensions between countries which are rich and those which are poor are expected to increase. The population "bulge" will disrupt the overall structure in the next 50 years in the United States. Migration factors including north-to-south and rural-to-urban population shifts will continue. Environmental problems are serious enough to cause real cutbacks in commitments and threaten the eventual health and safety of our nation. Energy and resource availability will cause infrastructure shifts which make the maintenance of present capital difficult. The climate, although usually stable, has some meteorologists concerned. Telecommunications is the next revolutionary force, which will probably then be followed by a revolution in genetic technology.

Education includes life-long learning and is not limited to the schoolroom. Different people benefit from different educational experiences.

There is a need for more effective community control of the educational system. We need to look further at the implications of these factors for education. Two fundamental forces dominating the '80s were described by Theobald. First, there are people who are "prime movers," who are aware of the future and willing to change "images" people have; and, second, the computer/microelectronics revolution which will force changes in the collection, the organization, and the dissemination of information. The use of the first of these fundamental forces, the prime movers, can be accomplished by moving information through invisible networks rather than through formal channels. Ideas can be moved through systems without the use of formal power. Many past dissemination efforts did not work because new channels for moving information were created instead of using those already developed. The other major force of the '80s, the development of an interactive knowledge-base, has two parts. One type of information system must be available if better decisions are to be made for education and society. Another information system deals with providing better access to information banks and existing data. The first type of information system should have data bases which are made more accessible to citizens and educators. The second information system has had very little work accomplished on it to this point. It involves new forms of knowledge-retrieval systems which would allow information to be structured in new ways and would permit access to key people when needed. Instructional development has the responsibility for taking a leadership role in developing the frontiers of education. Instructional development can play an essential role in the development of the knowledge-base and in its transmission, thus helping to make it possible for education to actually facilitate the "survival" of man in a new age.

CONCLUSION

The material cited in this chapter shows a world in the process of change. This change is occuring not only in terms of surface-structure, many of the details of which were revealed in the preceding discussion, but, of greater significance, in terms of foundational structure.

The implications of this foundational change for the practice of instructional development are to be found through an examination, not so much of I.D. itself, but of those areas forming the foundation upon which I.D. rests. Three of these areas were examined. These areas were (1) the technological tools used by developers, (2) the psychological structure of the learner, and (3) the social fabric within which learning occurs.

It was found that significant new tools will become available for the instructional developer which potentially will change not only the efficiency of the teaching process, but its very nature. It can no longer be taken for granted that most learning will occur within the walls of educational institutions, or that it will be directed by professional educators.

New concepts of man are emerging which will profoundly effect the way in which learning, teaching and communication in general will be conceptualized. The instructional developer must be concerned with such problems as the development of world-views, chemical learning, and the emergence of human-computer hybrids. No longer can visual literacy, for example, be studied solely in terms of the effects of color or picture-placement upon learning from text, or of behavioral effects resulting from television viewing. The teaching of visual literacy may involve, in the future, direct brain stimultion, chemical memory enhancement, and the altering of world-views in order to provide a fuller comprehension of art.

Instructional developers must become "prime movers" if they are to play a role in the future. In order to become prime movers, the strongest implication of this chapter must be actualized: the instructional developer must not only be trained to become a prime mover, but must be trained to function ambiguously in an ambiguous world. He must not be trained in specific skills to be followed religiously, but must be trained to change skills, even to change world-views, as this becomes necessary or appropriate. The instructional developer must not only be flexible, adapting efficiently and effectively to change as it becomes manifest, but must be a leader in producing and directing this manifestation of change.

This necessity for flexibility goes far beyond what is currently thought of as innovativeness. It requires that the world-view of the instructional developer be always a step ahead of what is, concentrating upon what could be. It requires an ability to operate within the here-and-now without being restricted in thinking to either the here or the now. The instructional developer, in short, must be a person functioning efficiently in the ambiguous world of today while simultaneously transforming today's ambiguities into the equally ambiguous, but different, ambiguities of tomorrow. To do this successfully, s/he must operate systematically, but s/he must also recreate her/his system as s/he goes. In the terms currently in use in ID, s/he must be system-bound latitudinally, but must be system-independent longitudinally.

The assumption that instructional developers are capable of operating as prime movers implies that programs training such developers exist. Thus, programs for selecting and training instructional developers must become, in fact, programs for training world-changers. Either this will happen, or instructional development will always be in a state of "future shock," if it does not cease to exist altogether.

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